Tender notification for procurement of single molecule conductance measurement instruments

To Whom It May Concern

22.11.2019

This is a Request for Quotations for procurement of the following single molecule conductance measurement instruments for establishing the "Single Molecule Science Laboratory" in the Department of Inorganic and Physical Chemistry (IPC) at IISc, Bangalore.

1. Mechanically Controllable Break Junction (MCBJ) Controller with Ultra low current Measurement Capability and Large Dynamic Current Measurement Range.

2. Ultra-Sensitive Electrochemical STM- based break Junction (EC-STM BJ) Controller.

Procedure:

1. Vendors will be required to submit a technical bid and a commercial bid in two separate sealed envelopes. Quotations should clearly indicate the terms of delivery, delivery schedule, entry tax, payment terms etc. Only vendors who meet the technical requirements will be considered for the commercial negotiation.
2. The decision of purchase committee will be final.
3. The technical proposal should contain a duly signed compliance certificate (please see the attached compliance certificate format below).
4. Any additional capabilities or technical details, that you would like to bring to the attention of the purchase committee, can be listed at the end of the technical specifications table.
5. The quotes should be CIP Bangalore, India.
6. Please provide itemized quotes for the instruments and any additional options/attachments/packages.
7. Comprehensive warranty for all the items must be 2 years (calculated from date of installation and commissioning of the instrument). As an additional option, please provide cost of an annual maintenance contract (AMC) for 3 years, post warranty.
8. The deadline for submission of proposals is the 12th of December 2019, 5:30 pm Indian Standard Time. Quotations should arrive at the following address:

   The Chairman
   Department of Inorganic and Physical Chemistry
   Indian Institute of Science
   Bangalore, INDIA-560012.
   Email: office.ipc@iisc.ac.in
   Tel: +91-80 2293 2382.

9. Any questions or clarifications can be directed to:
   Dr. Veerabhadrarao Kaliginedi
   Assistant Professor
   Room No: A104
   Department of Inorganic and Physical Chemistry
   Indian Institute of Science
   Bangalore, INDIA-560012.
   Email: vkaliginedi@iisc.ac.in
   Tel: +91-80 2293 3185.

Specifications

I. Mechanically Controllable Break Junction (MCBJ) Controller:

Controller capabilities hardware and software: This controller will be used measure the conductance through single molecule junction under ambient conditions in liquid environment. The device must be able to control and synchronize with an external stepper motor (for course movement) and piezo stack (fine movement) movement while performing current measurements. It should be able to measure large sets of data (few thousands of curves) for the following type of single molecular experiments:

1. Current-distance spectroscopy (50uA to 1pA with sampling rate >20 kHz, must be able to measure large sets of data). With additional possibility to perform current-distance spectroscopy measurements under electrochemical conditions.
2. Current-Voltage spectroscopy during the single molecule break junction experiments (with high data sampling rate > 20 kHz and must be able to measure large sets of data).
3. Piezo movement modulation based single molecule conductance measurements (should be able to control the piezo movement within few angstrom precision).
4. Molecular junction breakdown experiments: Stability and rupture of single molecular junctions under high bias voltage.
5. All above experimental modes should be as per user specifications and should allow further modifications (both hardware and software).

Required measurable Dynamic current range:

- Current Ranges from 100uA to 1pA (should be able to measure whole current range during the current distance spectroscopy measurement)
- Sampling rate >100 kHz
- Resolution 16bit
- At least 2 current measurement channels.
- Each channel should have the possibility to be biased relative ground.
    - At least one channel should have a bias voltage dynamically updated using waveforms

Stepper motor and Piezo Stack Controlling capability:

- Controllable voltage with a range of more than 0-10V
    - Dynamically updated using waveforms (>100kHz sampling rate)
- True Analog Ramping from 1mV/s to 100V/s (i.e. not digitized steps)
- External triggering sources
    - For switching the piezo ramping direction based on the measured current from either channel
    - For pausing the piezo ramping based on the measured current from either channel

Accessories: All necessary accessories like low noise cables with suitable connectors (as per user specification), calibration accessories should be provided.

Analysis software: Analysis software should be able to analyse large data sets of single molecule conductance measurements (current-distance curves, current-voltage curves and etc). Analysis software should have options to build conductance histograms (1D and 2D conductance histograms), correlation analysis and other advanced statistical methods to analyse the single molecule conductance data. Should allow further programming modification.

Possibility for the further modifications and customization: System (both hardware and software) should be modular and should provide possibility for the additions and modifications for the future single molecule experiments.

II. Ultra-Sensitive Electrochemical STM- based break Junction (EC-STM BJ) Controller:

Controller capabilities hardware and software: This controller will be used measure the conductance through single molecule junction under ambient conditions in liquid environment

(both electrochemical and nonelectrochemical environment). The system must be able to control and synchronize a stepper motor, movements of a piezo stack while measuring current. The ramping of the piezo stack should be controlled by the current data so that the ramping direction can either change, or halt.
The system should be able to measure large sets of data (few thousands of curves) for the following type of experiments:

1. Current-distance spectroscopy (50uA to 1pA with sampling rate >20 kHz) under electrochemical and nonelectrochemical conditions.
2. Current-Voltage spectroscopy during the break junction experiments (At least 10 I-V curves per one stretching cycle (i.e., one current-distance trace), with high data sampling rate > 20 kHz and must be able to measure large sets of data).
3. Piezo movement modulation based single molecule conductance measurements (should be able to control the piezo movement within few angstrom precision).
4. Thermo-power measurements. If available, an option to control the temperature of the substrate should be provided.
5. All above experimental modes should be as per user specifications and should allow further modifications (both hardware and software).

Bi-Potentiostat module for electrochemical STM-based Break junction measurements:

- Bi-Potentiostatic mode, i.e. control of the voltage difference between two working electrodes with respect to a reference electrode.
- Multiple feedback speed settings (>4)

Required measurable Dynamic current range:

- Current Ranges from 100uA to 1pA
  - Logarithmic i-v converter that covers the whole range.
- Sampling rate >100 kHz
- Resolution 16bit
- At least 2 current channels.
- Each channel should have the possibility to be biased relative ground.
  - At least one channel should have a bias voltage dynamically updated using waveforms

Piezo Stack Controller:

- Controllable voltage with a range of more than 0-10V
  - Dynamically updated using waveforms (>100kHz sampling rate)
- True Analog Ramping from 1mV/s to 100V/s (i.e. not digitized steps)
  - Ramp limits changeable
  - Maximal Range (upper limit relative lower limit) > 2V
- External triggering sources
  - For switching the piezo ramping direction based on the measured current from either channel
  - For pausing the piezo ramping based the measured current from either channel

Accessories: All necessary accessories like low noise cables with suitable connectors (as per user specification), calibration accessories should be provided.
Analysis software: Analysis software should be able to analyse big data sets of single molecule conductance measurements (current-distance curves, current-voltage curves and etc). Analysis software should have options to build conductance histograms (1D and 2D conductance histograms), correlation analysis and other advanced statistical methods to analyse single molecule conductance data. Should allow further programming modification.
Possibility for the further modifications and customization: System (both hardware and software) should be modular and should provide possibility for the additions and modifications for the future single molecule experiments.

Terms and conditions:

1. The vendor should have a track record of having previously supplied similar equipment's (please furnish details).

2. The lead time for the delivery and installation of the equipment should not be more than three months from the date of receipt of our purchase order. The delivery time should be indicated in the quote.
3. The bid will be considered valid for 90 days after the last date of bid acceptance.
4. The payment terms should be specified in the commercial proposal and is subject to negotiation.
5. Vendor should quote the latest model available with them to meet the tender specifications.
6. The price quoted should include must carry a comprehensive warranty of 2 years from the date of installation. Additional warranty for 3 years (total of 5 years) may be given as an option.

Compliance certificate

Mechanically Controllable Break Junction (MCBJ) Controller with Ultra low Current Measurement Capability and Large Dynamic Current Measurement Range				
S.No	Technical speciation	Yes	No	Extent of deviation and reason for deviation
1	Current-distance spectroscopy (50uA to 1pA with sampling rate >20 kHz, must be able to measure large sets of data> 10000 curves). With additional possibility to perform current-distance spectroscopy measurements under electrochemical conditions.			
2	Current-Voltage spectroscopy during the single molecule break junction experiments (with high data sampling rate > 20 kHz and must be able to measure large sets of data >1000 curves).			
3	Piezo movement modulation based single molecule conductance measurements (should be able to control the piezo movement within few angstrom precision).			
4	Molecular junction breakdown experiments: Stability and rupture of single molecular junctions under high bias voltage.			
5	All above experimental modes should be as per user specifications and should allow further modifications (both hardware and software).			
6	**Required measurable Dynamic current range:** • Current Ranges from 100uA to 1pA (should be able to measure whole current range during the current distance spectroscopy measurement) • Sampling rate >100 kHz • Resolution 16bit • At least 2 current measurement channels. • Each channel should have the possibility to be biased relative ground. o At least one channel should have a bias voltage dynamically updated using waveforms			
7	**Stepper motor and Piezo Stack Controlling capability:** • Controllable voltage with a range of more than 0-10V o Dynamically updated using waveforms (>100kHz sampling rate) • True Analog Ramping from 1mV/s to 100V/s (i.e. not digitized steps) • External triggering sources			

	○ For switching the piezo ramping direction based on the measured current from either channel ○ For pausing the piezo ramping based on the measured current from either channel			
8	**Stepper motor and Piezo Stack Controlling capability:** • Controllable voltage with a range of more than 0-10V ○ Dynamically updated using waveforms (>100kHz sampling rate) • True Analog Ramping from 1mV/s to 100V/s (i.e. not digitized steps) • External triggering sources ○ For switching the piezo ramping direction based on the measured current from either channel ○ For pausing the piezo ramping based on the measured current from either channel			
9	**Analysis software:** Analysis software should be able to analyse large data sets of single molecule conductance measurements (current-distance curves, current-voltage curves and etc). Analysis software should have options to build conductance histograms the following histograms form current-distance spectroscopy 1. 1D and 2D conductance histograms. 2. Plateau length histograms 3. Correlation analysis and other advanced statistical methods to analyse the single molecule conductance data. 4. Analysis program should allow further programming modifications by the users.			
10	**Possibility for the further modifications and customization:** System (both hardware and software) should be modular and should provide possibility for the additions and modifications for the future single molecule experiments.			
Ultra-Sensitive Electrochemical STM- based break Junction (EC-STM BJ) Controller				
1	Current-distance spectroscopy (50uA to 1pA with sampling rate >20 kHz and must be able to measure large sets of data> 10000 curves) under electrochemical and nonelectrochemical conditions.			
2	Current-Voltage spectroscopy during the break junction experiments (At least 10 I-V curves per one stretching cycle (i.e., one			

	current-distance trace), with high data sampling rate > 20 kHz and must be able to measure large sets of data).			
3	Piezo movement modulation based single molecule conductance measurements (should be able to control the piezo movement in few angstrom precision).			
4	Thermo-power measurements. If available, an option to control the temperature of the substrate should be provided.			
5	All above experimental modes should be as per user specifications and should allow further modifications (both hardware and software).			
6	**Bi-Potentiostat module for electrochemical STM-based Break junction measurements:** • Bi-Potentiostatic mode, i.e. control of the voltage difference between two working electrodes with respect to a reference electrode. • Multiple feedback speed settings (>4)			
7	**Required measurable Dynamic current range:** • Current Ranges from 100uA to 1pA o Logarithmic i-v converter that covers the whole range. • Sampling rate >100 kHz • Resolution 16bit • At least 2 current channels. • Each channel should have the possibility to be biased relative ground. o At least one channel should have a bias voltage dynamically updated using waveforms			
8	**Piezo Stack Controller:** • Controllable voltage with a range of more than 0-10V o Dynamically updated using waveforms (>100kHz sampling rate) • True Analog Ramping from 1mV/s to 100V/s (i.e. not digitized steps) o Ramp limits changeable o Maximal Range (upper limit relative lower limit) > 2V • External triggering sources o For switching the piezo ramping direction based on the measured			

	current from either channel ○ For pausing the piezo ramping based the measured current from either channel			
10	**Analysis software:** Analysis software should be able to analyse large data sets of single molecule conductance measurements (current-distance curves, current-voltage curves and etc). Analysis software should have options to build conductance histograms the following histograms form current-distance spectroscopy 1. 1D and 2D conductance histograms. 2. Plateau length histograms 3. Correlation analysis and other advanced statistical methods to analyse the single molecule conductance data. 4. Analysis program should allow further programming modifications by the users.			
11	**Possibility for the further modifications and customization:** System (both hardware and software) should be modular and should provide possibility for the additions and modifications for the future single molecule experiments.			